ORIGIN AND CLASSIFICATION OF MANGO VARIETIES IN HAWAII

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Mangos (*Mangifera indica*) are widely grown as a home garden fruit in the warmer, drier areas of all major islands of Hawaii. The fruit is mostly consumed fresh as a breakfast or dessert fruit. Small quantities are also processed into mango seed preserves, pickles, chutney, and sauce.

Production

Most mangos in Hawaii are grown in dooryards and home gardens. Although commercial production has been attempted, acreages remain small. Production from year to year tends to be erratic, which has resulted in limited commercial success. Shipment to the U.S. mainland is presently prohibited due to the presence in Hawaii of tephritid fruit flies and the mango weevil, *Cryptorhynchus mangiferae*, which is not found in other mango-growing areas of the United States. Opening of the U.S. market through development of an effective treatment to disinfest mangos of the mango weevil and fruit flies would improve the potential for commercial production. It is not known when or if this will occur.

Cultivar Types

Mango cultivars in Hawaii are classified by embryo type: polyembryonic and monoembryonic. *Polyembryonic* varieties develop multiple embryos, of which all except one arise from nucellar (i.e., maternal) tissue in the developing seed. Because of this, most seedlings from polyembryonic seeds are genetically identical to the mother tree. The single gametic embryo of such seeds, originating from the sexual process of pollination, is often so underdeveloped and weak that it fails to germinate. *Monoembryonic* varieties produce seeds with a single gametic embryo developed as a result of the sexual process. Among seedling trees of monoembryonic varieties, fruits vary widely in quality and appearance.

In addition to type of embryo produced, mango cultivars can also be classified according to origin (see Table 1). Some mangos in Hawaii derived from early polyembryonic introductions are known as "Hawaiian" mangos. Another type of polyembronic mango that became popular in Hawaii was the "Chinese" mango ('No. 9'), originally from the West Indies, but so called because it was frequently grown by persons of Chinese ancestry. Indian mangos are mostly monoembryonic types originating on the Indian subcontinent, a center of mango diversity. Many monoembryonic mango cultivars have been introduced to Hawaii as a result of their introduction and selection in Florida, an important center of mango growing in the Americas. Finally, several cultivars, mostly seedlings of monoembryonic cultivars, have been selected and named in Hawaii (Tables 1 and 2).

Cultivar Introduction and Selection

The exact date of the first introduction of mangos into Hawaii is not known. In attempting to trace the date of introduction, a number of different lines of evidence and interpretations are encountered. The first documented date of introduction appears to be 1824, when Captain Meek of the brig *Kamehameha* brought several small mango plants from Manila. These plants were divided between Don Marin, a Spanish horticulturist in Honolulu, and Reverend Joseph Goodrich, a missionary in Wailuku, Maui.

According to the published diary of Andrew Bloxam, a midshipman aboard the *H.M.S. Blonde*, a British Navy frigate, three small mango trees were brought to Honolulu from Valparaiso, Chile, on this ship in 1825. These trees were planted and presumably survived. Bloxam's diary also provides a list of some of the economic plants already growing in Hawaii prior to 1825, which did not include mango. Although both the 1824 and 1825 dates seem well documented, some authorities have stated that mangos were introduced to Hawaii before 1824. Dr. Willis T. Pope stated that mangos were probably imported from Mexico by Don Marin sometime between 1800 and 1824. It has not been possible to provide more definite information or a specific date relating to this presumed earlier introduction. Subsequently, however, in an unpublished manuscript, Pope mentioned 1824 as the probable date of the first

Table 1. Classification of mango varieties in Hawaii.

Recommendation status for Hawaii	Origin			
	Hawaii	India	Florida	Other countries and states
Suggested for commercial use	Harders Rapoza	none	Keitt	Manzanillo (Mexico)
Suggested for home gardens	Ah Ping Exel Gouveia Harders Kurashige* Momi K Paris Selection No. 1* Pope Rapoza White Pirie	Basti No. 3 Fernandin Himsagar Itamaraca Pirie	Brooks Late Edwards Keitt Haden Zill	Harumanis* (Indonesia) Fairchild (Panama) Julie (Trinidad) Kensington* (Australia) Manzanillo (Mexico) Otts (California) Tete Nene (Puerto Rico)
Undergoing testing	Adams Buchanan Fukuda Milda Waianae Beauty Wong	Alphan Amin Ibrahimpur Amin Sahai Chowsa Dasheri Fazli Zafrani Husnara Janardin Pasand Langra Padiri Pulihora Taimuria Zardalu	Carrie Eldon Fascel Jacquelin Ruby Simmonds Smith-Haden Sunset Van Dyke Zill Late	Apple* (Kenya) Ataulfo (Mexico) Borbon (Paraguay) Carabao* (syn. Manila)(Philippines) Extrema (Paraguay) Fall (China) Fire Red (China) Francis (Haiti) Graham (Panama) Keowsavoy* (Thailand) Mandeler (China) Milk (China) Mun (Thailand) Nangsangwon* (Thailand) Oakrong* (Thailand) Wa Great (China)

*Polyembryonic cultivar.

introduction of mango plants into Hawaii.

Another report of an early introduction is found in an undated publication by John Cook. In this account of historical events of the times, Cook stated that the first mango tree planted in the territory was growing in Kalihi on the property of Captain Alexander Adams. Captain Adams is said to have grown this tree from seed he obtained on a trading vessel from South China which he visited in Honolulu harbor.

From these accounts, it appears that mangos were introduced into Hawaii sometime before 1825, probably from several different sources.

Before 1899, when S. W. Damon of Honolulu introduced several grafted trees of Indian varieties, most mango trees in Hawaii were seedlings of the polyembryonic type commonly referred to as "Hawaiian" mangos. These were also called 'Manini' mangos, after the name given to the horticulturist Don Marin by Hawaiians. Because these seedlings apparently came from several different sources, individual trees of the

Table 2. Characteristics of some of the best mango cultivars recommended for growing in Hawaii.

Cultivar	Origin	Bearing season	Fruit size (oz)	Fruit quality	Bearing character
Ah Ping	Hawaii	June – July	16 – 32	Good	Moderate yield, regular
Fairchild	Panama	June – July	8 – 12	Good	Moderate yield
Gouveia	Hawaii	July – August	12 – 16	Excellent	Moderate yield
Harders	Hawaii	June – August	10 – 12	Good	Regular
Keitt	Florida	August – October	15 – 30	Excellent	High yield, regular
Manzanillo	Mexico	June – July	20 – 30	Good	Moderate yield, regular
Momi K	Hawaii	June – July	10 – 12	Good	Moderate yield, regular
Pope	Hawaii	July – September	10 – 16	Good	High yield, regular
Rapoza	Hawaii	August – October	25 – 35	Excellent	Heavy yield, regular

"Hawaiian" mangos often differ in tree characteristics as well as fruit form, shape, and flavor.

Although polyembryonic seedlings of the "Hawaiian" type mangos have been widely distributed on all six major inhabited islands, they have never been grown on a commercial scale. More than 40 polyembryonic seedling selections have been described and given names (Tables 1 and 3). Some of the better "Hawaiian" varieties are still being grown as dooryard fruit trees, but none of them have become important varieties. Seedlings of the general "Hawaiian" type are found growing along roadsides and in pastures and marginal lands throughout the state. The fruit of these "Hawaiian" seedling mangos is usually somewhat fibrous, with a turpentine odor, and not much sought after except by children. Although not marketable as dessert fruit, "Hawaiian" mangos are often processed into mango seed preserves, pickled mango, and chutney.

In 1903 the Hawaii Agricultural Experiment Station was established, and testing of mango varieties for adaptation, quality, and productivity began. Up to the present time, nearly 200 varieties have been evaluated. Many of these have been discarded for various reasons including unsatisfasctory production, inferior quality, unattractive color, and susceptibility to anthracnose caused by the fungus *Colletotrichum gloeosporioides*. Anthracnose resistance, or at least some degree of tolerance, is necessary in mangos grown in Hawaii. This is because rainy weather and high humidity frequently occur during the flowering season. Under these conditions susceptible varieties usually set few or no fruits.

Many of the older varieties grown before 1940 have become obsolete or extinct. Table 3 lists mango cultivars tested to date but not presently recommended. Some of these cultivars are superior in other regions but do not perform well or produce acceptable fruit when grown in Hawaii.

Individuals may prefer varieties that cannot be generally recommended. Many cultivars listed in Table 3 may have value for certain persons and purposes.

Cultivars Grown in Hawaii

'Haden' originated from a 'Mulgoba' seedling grown in Florida in 1902. It has been the most widely planted mango in Hawaii. The fruits are medium-large, weighing 16 to 24 oz. The attractive skin color of 'Haden' fruit, crimson over a deep yellow undercolor, has helped to support this cultivar's popularity. Although 'Haden' was undoubtedly superior to most local cultivars at the time of introduction in Hawaii, it has since been ranked considerably below several other cultivars in taste panel studies (Table 4). The fruit flesh is somewhat fibrous and tends to separate from and deteriorate around the seed, resulting in marginal quality and poor shelf life. 'Haden' seeds are relatively large, and the trees usually develop an undesirable alternate-year bearing habit. All the cultivars recommended here for commercial or home garden planting are superior to 'Haden' in fruit quality and bearing habit.

'Gouveia' was named in 1964 for Mrs. Ruth Gouveia of Palolo Valley, Oahu, who planted the seed from which the original seedling tree grew. 'Gouveia' is probably a seedling of the 'Pirie' cultivar. The trees produce excellent quality,

medium-sized fruits that are distinctively aromatic and highly flavored. 'Gouveia' is best adapted to "ideal" mango-growing areas, which are warm, sunny, and relatively dry. The quality and bearing do not develop well in marginal areas which are cool and humid during flowering and fruit setting.

'Harders' is an excellent variety for both commercial and home garden plantings. It originated from a tree of unknown parentage grown in Manoa, Oahu, recognized by Robert M. Warner, a University of Hawaii horticulturist in the mid-1970s. 'Harders' produces attractive, highly colored, medium-sized fruits of very good quality. The trees bear regularly and frequently produce off-season fruit in late fall and winter.

'Ah Ping' originated as a seedling planted by Mrs. Chun Ah Ping of Mapulehu, Molokai. The fruits are medium-large, ranging from 16 to 32 oz, and have a very attractive skin color similar to that of 'Haden'. Fruit appearance is excellent and quality is good. The fruits generally ripen in June and July.

'Pope' is a consistently high-yielding, regular-bearing cultivar selected by R. A. Hamilton and named in 1960 in honor of Willis T. Pope, horticulturist at the Hawaii Agricultural Experiment Station from 1920 to 1937. 'Pope' originated in Hawaii from a seedling of the variety 'Irwin', from Florida. 'Pope' mangos mature in July and August. Fruits are medium in size (12 to 18 oz). The undercolor of ripe fruit is greenish yellow, which in the popular conception is less desirable than yellow undercolor. Fruit quality is much better than 'Haden'.

'Keitt' originated in Florida as a seedling of 'Mulgoba'. 'Keitt' is presently the best export variety in the Americas. It bears well and late in Hawaii, usually maturing one to two months after midseason cultivars. The fruits weigh from 15 to 30 oz, and the flavor and quality are excellent.

'Momi K' originated from a seedling grown in Waipahu, Oahu, by Mrs. (Oliver) Ka Lei Momi Kinney. It was evaluated by University of Hawaii horticulturists in 1957. The trees bear regularly, producing moderate crops of very good quality, mild-flavored, medium-sized fruits, maturing in June and July.

'Fairchild' was introduced to Hawaii from Panama by Walter Lindsey in the 1920s. It produces small yellow fruits of very good quality weighing 8 to 12 oz. This cultivar is considered relatively tolerant of anthracnose and produces in areas considered marginal for mango production. It is recommended for home gardens in cool locations where wet, humid weather conditions usually result in poor production by other varieties.

'Rapoza' was selected about 1984 by R. A. Hamilton and J. H. Rapoza from a seedling of 'Irwin' grown at the University of Hawaii's Poamoho Research Station in the mid-1970s. It produces large, attractive, excellent quality fruits weighing 25 to 35 oz. It is generally late bearing, the fruits maturing over a long period from mid-July to October.

'Manzanillo', which originated in the state of Colima, Mexico, is probably a 'Haden' seedling. It was introduced to Hawaii in 1978. 'Manzanillo' produces large, attractive, mild-flavored fruits which are of good quality half-ripe as well as when fully ripe. The fruits usually mature in June and July.

Discussion and Summary

There is more interest developing in new fruit crops and new mango varieties than at any time in the past 50 years. Mangos have been grown in Hawaii for about 150 years but have not yet developed into a viable commercial industry. Climatic factors often adversely affect mango production in Hawaii and lead to poor quality and loss of crop from anthracnose and powdery mildew. Mangos nevertheless remain a favorite home garden fruit in Hawaii. Restrictions against exporting fresh mangos to the U.S. mainland remain in effect, but both Canada and Alaska accept mangos exported from Hawaii without restriction.

Insect and disease problems limit production, and some of these can be controlled. To date, however, very few control measures are applied to most of the mangos produced, which are grown mostly in small plots or as dooryard fruit trees. These problems are being addressed at this conference by other speakers.

Present plantings of mangos are mostly confined to a few old varieties such as 'Haden' and 'Pirie', which have serious shortcomings as commercial varieties. A number of new selected or imported varieties offer better possibilities. The older varieties 'Pirie' and 'Haden' are, however, so much better known and widely planted that no rapid change is likely to occur. New varieties bearing better crops of improved quality fruits with longer shelf life are only beginning to be planted experimentally.

It takes many years for new varieties to attain commercial status. In the case of macadamias, it

has taken about 20 years for new varieties to become accepted and planted on a commercial scale.

In the case of mangos it may take even longer, because old dooryard mango trees are seldom replaced after they are in production. There are presently nine excellent, relatively new mango varieties recommended for planting in Hawaii: one each from Florida, Mexico, and Panama, and six local selections (Table 2). This list does not include 'Haden' and 'Pirie', which are considered obsolete, although there are thousands of trees of these two varieties bearing in dooryard plantings throughout the state.

Garden shops and nurseries continue to advertise and sell 'Pirie' and 'Haden', because they are not well informed about better alternatives and because 'Pirie' and 'Haden' are what their customers ask for. I doubt if this will change quickly, although 'Rapoza', 'Harders', and other excellent home garden varieties are beginning to be propagated and sold on Oahu.

Mangos continue to be a favorite fruit in Hawaii. The search continues for better adapted varieties with higher quality fruits and more reliable bearing behavior than 'Haden' and 'Pirie'. Superior new varieties have been developed and are already available for planting. These new varieties can eventually replace the two older but less desirable varieties which now predominate only because they were introduced first.

Table 3. Mango cultivars tested but not presently recommended.

(Note: The varieties listed in this table have been evaluated but are not considered satisfactory by present standards of color, flavor, firmness, uniformity, productivity, or disease tolerance. Most of these varieties are no longer cultivated. It is understandable that individuals may be partial to certain varieties on this list and therefore continue to grow them for home use.)

Alphonse
Amini
Ameeri
Banganapalli
Batu Ferringhi
Bennet's Alphonse
Bicknell
Bishop
Blackman
Borsha
Bombay
Bombay Yellow
Brindabani
Calidad
Cambodiana
Cherukurasam
Chinese
Cigar
Cogshall
Crescent
Cowasji Patel
D'or
Earlygold
Ehrhorn
Ewa
Farrar
Fiji Long
Fiji Short
Freitas
French Wine
Georgiana
Hansen
Harries
Helens
Himayuddin
Holt
Irwin
Jamshedi
Joe Welch (syn. Mapulehu)
Kalihi
Kent
Kinney
Larnach
Lazarus
Lemon Chutney
Lewis
Lippens
Lotts
Ludwig
Manini
Maya
McDougal
Mulgoa
Mulgoba
Mundappa
Murashige
Nam Doc Mai
Neelum
Nimrod
Non Plus Ultra
Oahu
Ono
Osteen
Opureva
Palmer
Paris
Parvin
Prince
R2T2
Roberts
S-T
Sandershaw
Schobank
Sensation
Shibata
Smith
Smith-Wooten
Som Keo Won
Steward
Suvarnarekha
Tamuriya
Tenney
Texeira
Tolbert
Tommy Atkins
Totapari
Van Raj
Victoria
Waterhouse
Whalen
Whitney
Wooten

Table 4. Taste panel scores for some mango cultivars grown at Poamoho Research Station, Oahu (from UH Cooperative Extension Service Circular 435, 1969).

Cultivar	Flavor	Texture	Skin color	Flesh color	Size and shape	Proportion of seed to flesh	Total
Gouveia	29.0	21.0	12.5	4.3	4.5	4.8	76.1
Pope	26.5	24.1	12.6	3.8	4.1	4.5	75.6
Momi K	25.7	22.5	14.0	3.7	3.0	4.4	73.3
Pirie	29.1	22.3	9.2	3.3	3.0	3.0	69.9
Zill	23.6	18.8	11.9	3.4	3.1	4.2	65.0
Haden	17.7	17.6	15.3	3.4	3.7	2.9	60.6
Joe Welch	17.2	18.9	11.3	3.2	4.2	4.1	58.9
Highest possible score	35.0	30.0	20.0	5.0	5.0	5.0	100.0